# The Changing Landscape of Chemical Toxicity Values and Possible Impacts to DoD Legacy Site Cleanup

**Anita K. Meyer DABT**
Environmental & Munitions CX
Huntsville Engineering and Support Center

SRA Annual Meeting
Charleston, SC
December 5, 2011

US Army Corps of Engineers
**BUILDING STRONG®**

# Report Documentation Page

*Form Approved*
*OMB No. 0704-0188*



| 1. REPORT DATE | 2. REPORT TYPE | 3. DATES COVERED |
|---|---|---|
| **05 DEC 2011** | | **00-00-2011 to 00-00-2011** |

| 4. TITLE AND SUBTITLE | 5a. CONTRACT NUMBER |
|---|---|
| **The Changing Landscape Of Chemical Toxicity Values And Possible Impacts To DoD Legacy Site Cleanup** | 5b. GRANT NUMBER |
| | 5c. PROGRAM ELEMENT NUMBER |
| 6. AUTHOR(S) | 5d. PROJECT NUMBER |
| | 5e. TASK NUMBER |
| | 5f. WORK UNIT NUMBER |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Environmental & Munitions CX,Huntsville Engineering and Support Center, Huntsville,AL,35807** | 8. PERFORMING ORGANIZATION REPORT NUMBER |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) | 10. SPONSOR/MONITOR'S ACRONYM(S) |
| | 11. SPONSOR/MONITOR'S REPORT NUMBER(S) |

12. DISTRIBUTION/AVAILABILITY STATEMENT
**Approved for public release; distribution unlimited**

13. SUPPLEMENTARY NOTES
**Presented at the Emerging Contaminants Program , 2011 Society for Risk Analysis Annual meeting, Charleston, SC, December 4-7, 2011**

14. ABSTRACT

15. SUBJECT TERMS

| 16. SECURITY CLASSIFICATION OF: | | | 17. LIMITATION OF ABSTRACT | 18. NUMBER OF PAGES | 19a. NAME OF RESPONSIBLE PERSON |
|---|---|---|---|---|---|
| a. REPORT **unclassified** | b. ABSTRACT **unclassified** | c. THIS PAGE **unclassified** | **Same as Report (SAR)** | **29** | |

# Emerging Contaminants (ECs)

- Are chemicals or materials of interest that are characterized by:
  - a perceived or real threat to human health or environment, and
  - there is no currently published health standard or there is an existing health standard, but *the standard is evolving or being re-evaluated*.

Source: "Initiation of Emerging Contaminants Characterization and Response Actions for Protection of Human Health" Issue Paper (ECOS & DoD Sustainability Workgroup, 2008)

# DoD's Scan, Watch, Action Process: Identifying, Prioritizing & Pursuing Risk Management


**Over -the- horizon**

**EC News**

Review literature, periodicals, regulatory communications, etc.

**Possible DoD impacts**

**Phase I Assessment**

Monitor events; Conduct Phase I qualitative impact assessment; Manage obvious risks.

**Probable high DoD impacts**

**Phase II Assessment**

Conduct Phase II quantitative impact assessment; Develop & rank risk management options (RMOs); Implement approved RMOs; Track implementation and reduce high risks; Revisit list annually for risk reduction progress and triggers for listing

**Risk Management Options to ECGC**

**Approved RMOs become Risk Management Actions (RMAs)**

# Trichloroethylene Final Sept. 2011

- Kidney cancer in workers basis of cancer toxicity values, adjusted to include liver and non-Hodgkins lymphoma
  - Mutagenic mode of action adjustment applicable only for kidney cancer
- Current drinking water regulation of 5 µg/L used for most cleanups

| Risk-Based Screening Levels* | | |
|---|---|---|
| | Res. Water (µg/L) | Air (µg/m$^3$) |
| Non-Cancer Hazard of 1 | 3.4 | 2 |
| $10^{-6}$ Cancer Risk | 0.65 | 0.59 |

*Using EPA Regional Screening Level Calculator

# Tetrachloroethylene

- 1998 initiated
- Nat'l Academy Review Feb 2006
- June 2008 external review version released
- If present, common source was dry cleaning facilities

| Risk-Based Screening Levels* | | | |
|---|---|---|---|
| | Res. Soil (mg/kg) | Res. Water Use (µg/L) | Indoor Air (µg/m$^3$) |
| Current | 0.55 | 0.11 | 0.41 |
| New (draft '08) | 0.293 | 0.179 | 0.122 |
| Sources of current toxicity values include EPA IRIS, ATSDR and CalEPA. Lowest RSL target risk = $10^{-6}$. | | | |

*Using EPA Regional Screening Level Calculator

# Other Chemicals of DoD Interest Undergoing IRIS Reassessment

- 1,4-Dioxane
- Dioxin
- RDX
- Arsenic
- Benzo(a)pyrene
- Relative potency factors for PAHs

# Shooting Trap and Skeet as Gunnery Training Component

**Students, Using Shotguns Specially Mounted on Turrets, Learn How to Operate the Turrets as they Fire at Clay Pigeons Released from 40-foot High Towers**

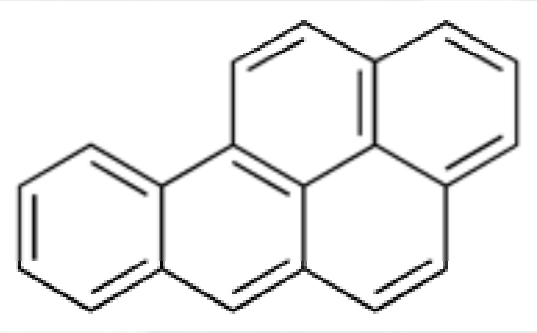
***Photos provided by: Kingman Army Airfield Historical Society***

# Target Composition

- Clay and binder; ~30% composition is coal tar pitch especially during 1940s
  - ►Provided the right balance between surviving throw and shattering when hit with shot
- Less toxic and more degradable targets now being manufactured
  - ►Petroleum pitch, soy etc
    - PAHs ~ 75% lower in petroleum pitch than coal tar pitch

# Coal Tar Pitch

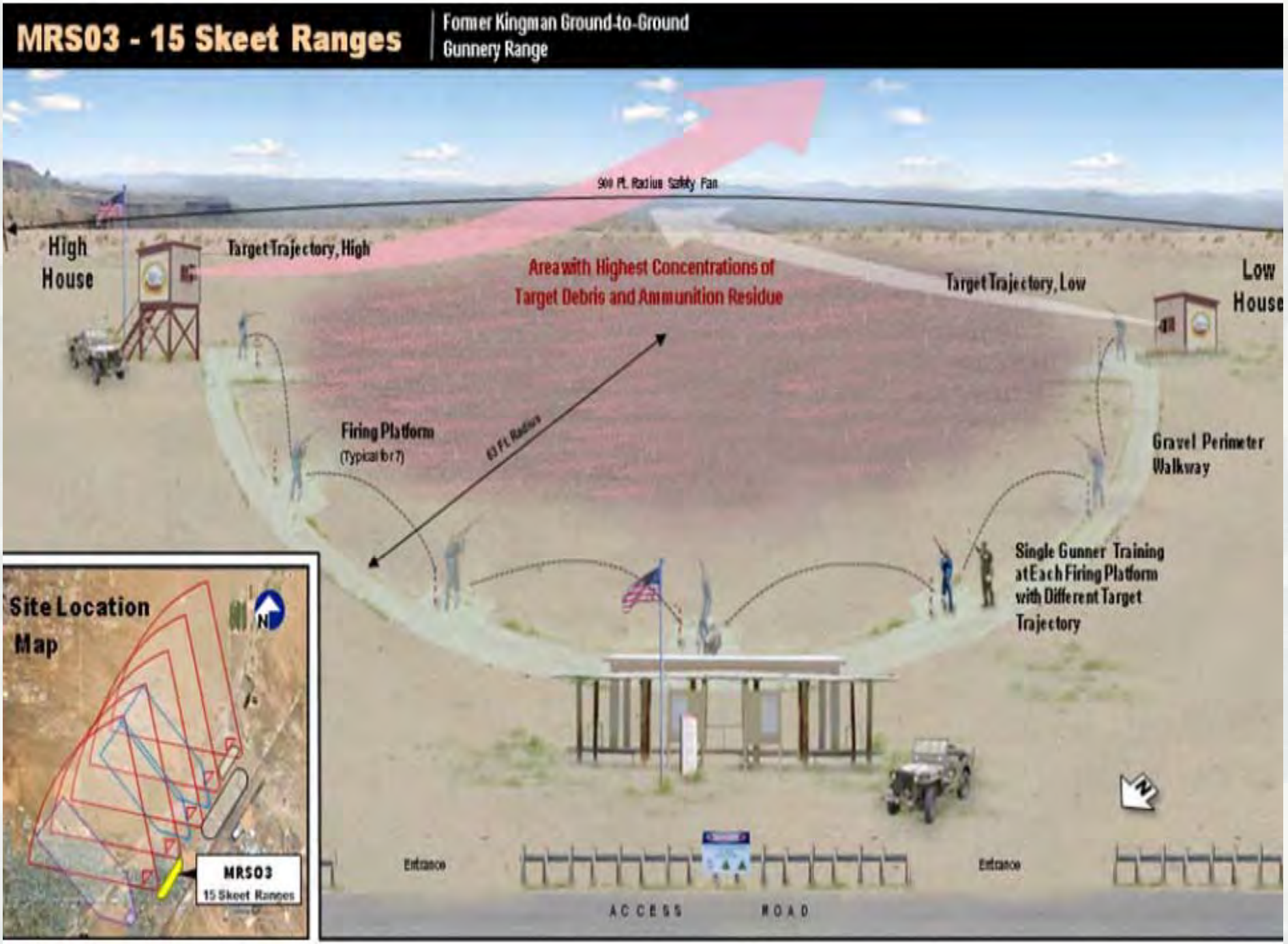
- Coal tar pitch is a complex mixture of organic compounds
- Polycyclic aromatic hydrocarbons (PAHs) chemical class of most concern due to toxicity
- Benzo(a)pyrene most studied
  - ►Carcinogen
- Low soil screening level; 15 µg/kg

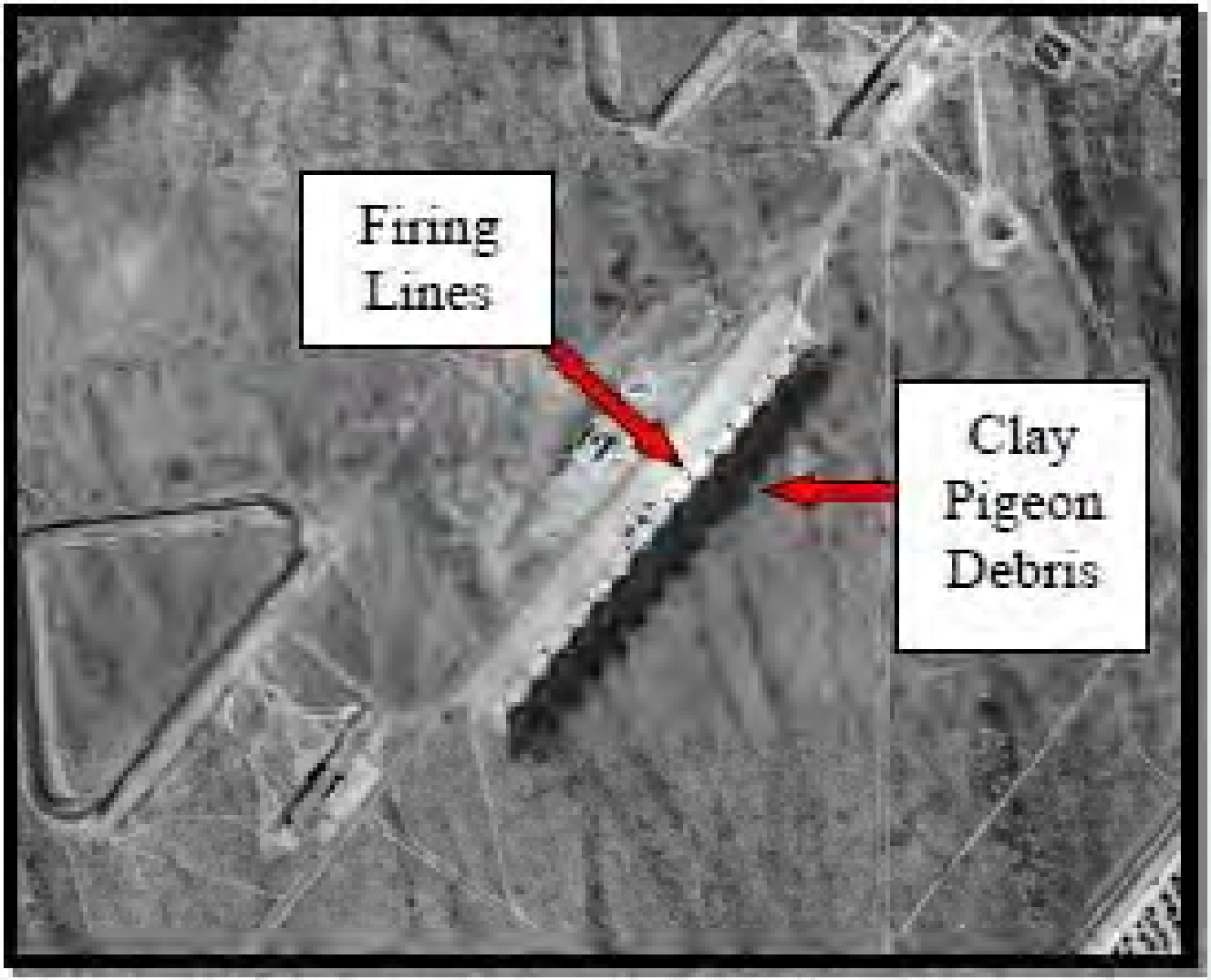


Source: EPA Regional Screening Level

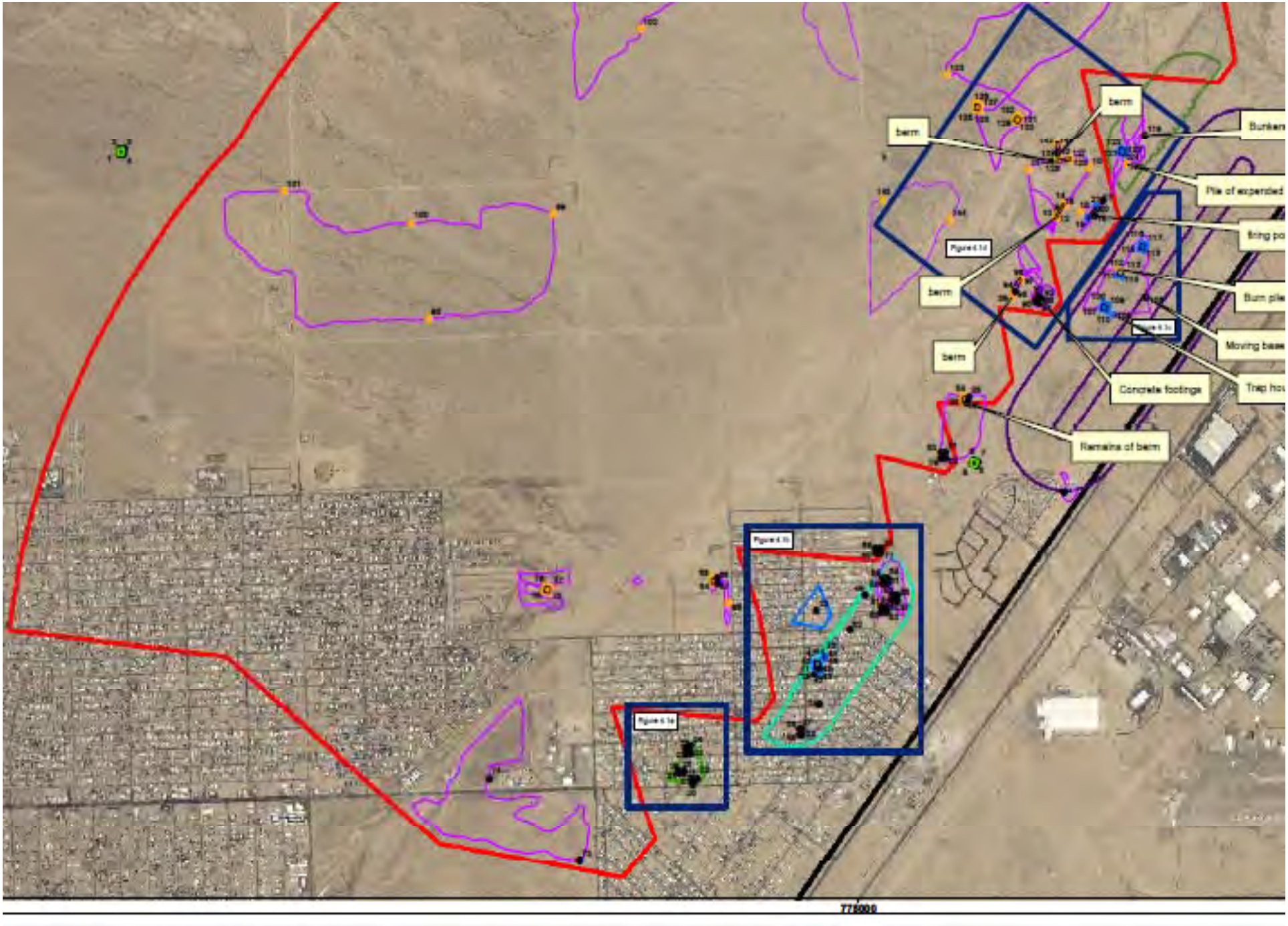
# Investigation Strategies

- Conceptual Site Model – consider past and subsequent site use
- PAHs in clay pigeons not highly mobile
  - ▶ Soil/sediment will be media of primary concern
- Consider ambient sources
  - ▶ Roadways
  - ▶ Runoff from surface sealant
  - ▶ Forensics may add value at some sites

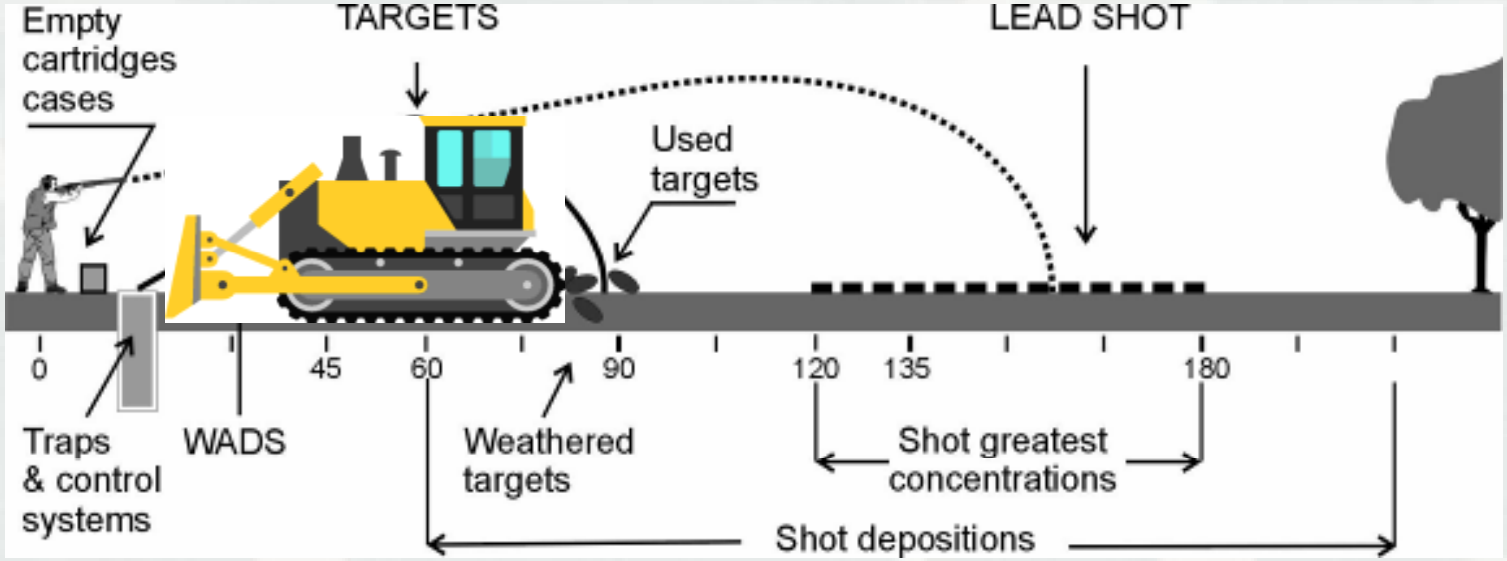

MRS03 - 15 Skeet Ranges
Former Kingman Ground-to-Ground Gunnery Range
900 Ft. Radius Safety Fan
High House
Target Trajectory, High
Area with Highest Concentrations of Target Debris and Ammunition Residue
Target Trajectory, Low
Low House
Firing Platform
(Typical for 7)
63 Ft. Radius
Gravel Perimeter Walkway
Single Gunner Training at Each Firing Platform with Different Target Trajectory
Site Location Map
N
MRS03
15 Skeet Ranges
Entrance
Entrance
ACCESS ROAD




1943 Aerial Photograph showing MRS03 – 15 Skeet Range


berm
berm
berm
berm
Concrete footings
Remains of berm
775000

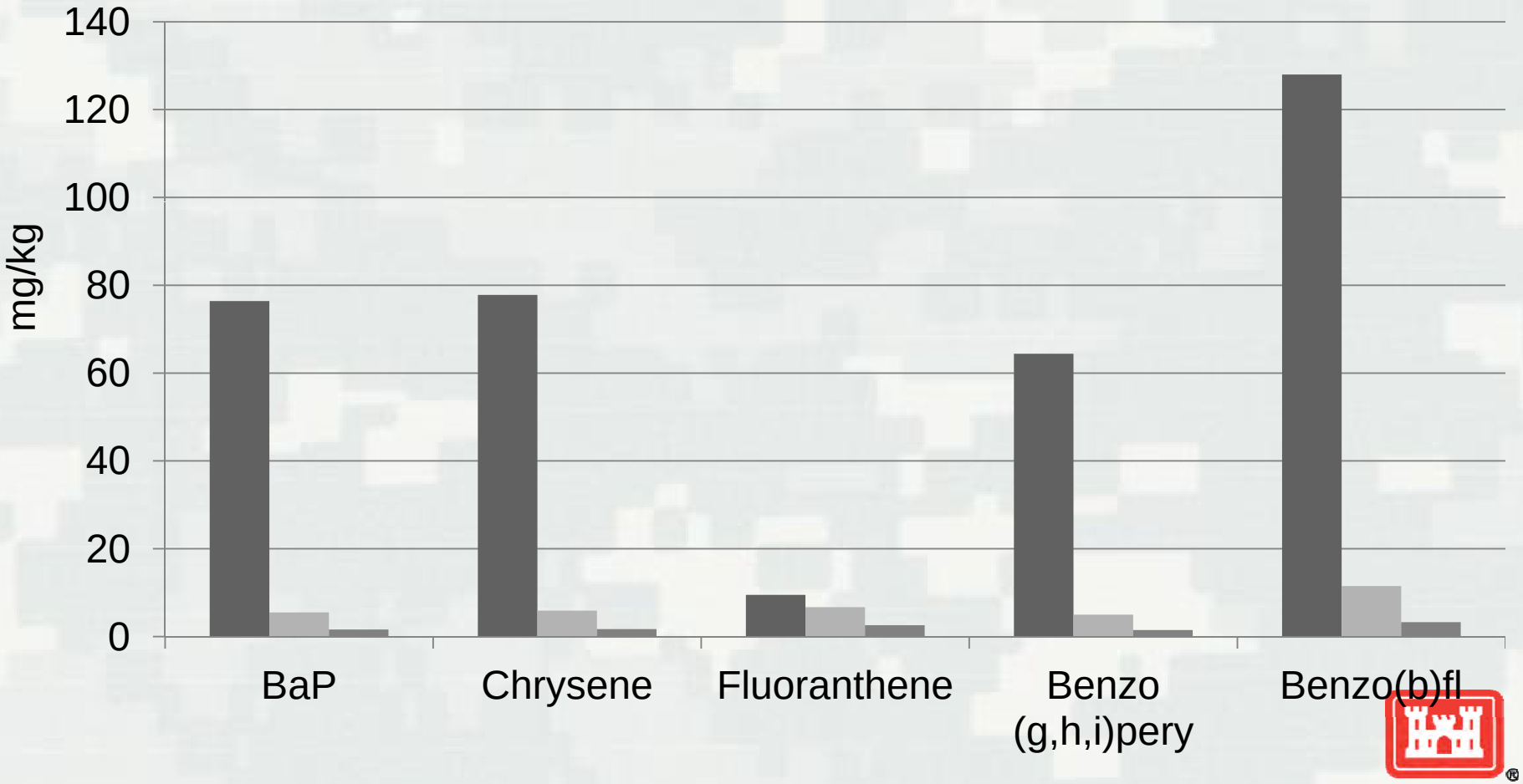
# Conceptual Model (cont.)



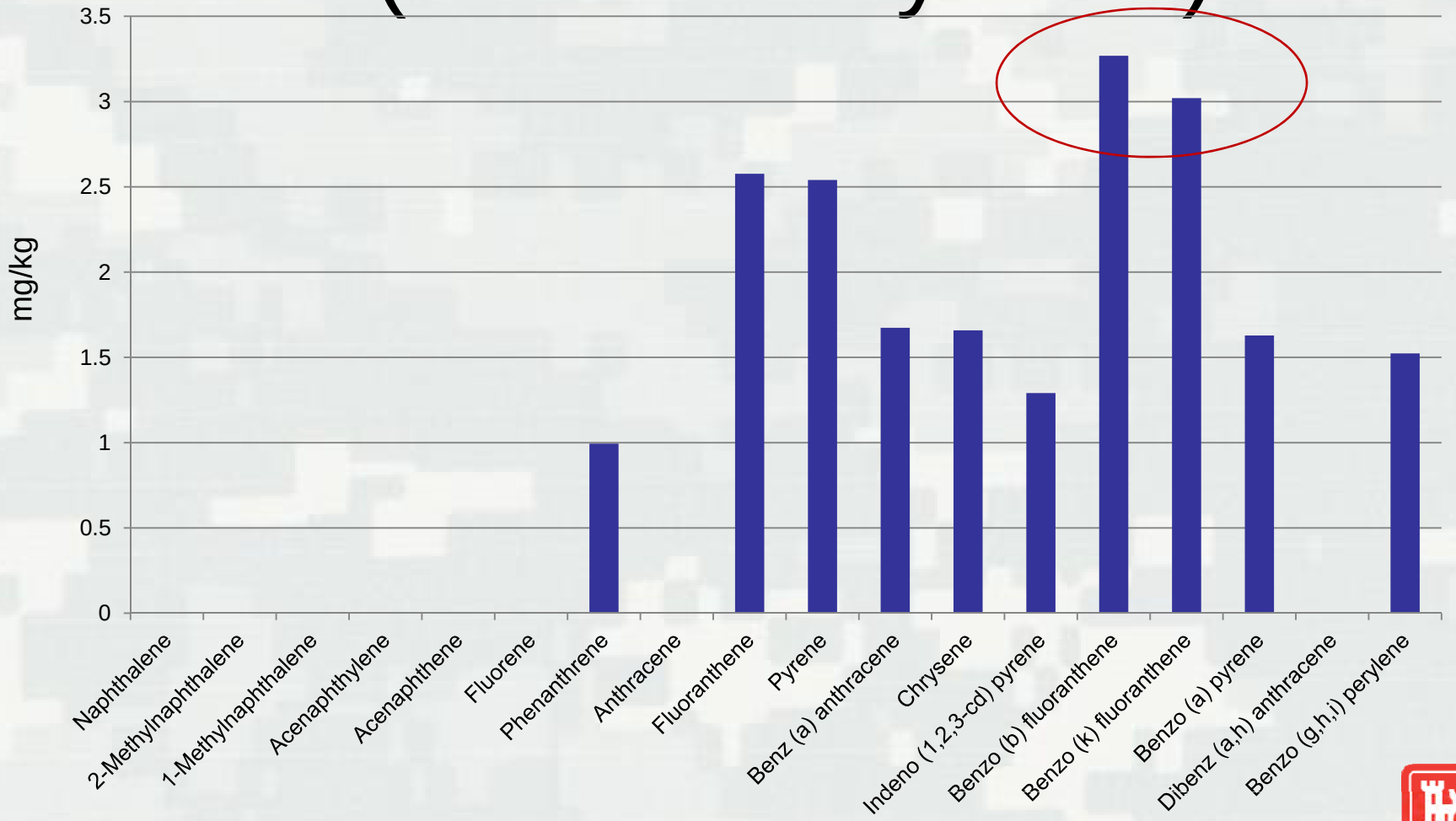

**Flight paths of different materials resulting from clay target shooting** (in meters, 1 m = 3.28 feet).

* ITRC, 2005

# Select PAHs from Sampled Areas



# Detected PAHs (Low Density Area)



# Emerging Contaminant Issue

- Benzo(a)pyrene under reevaluation by EPA IRIS program
- Another EPA NCEA document: "Development of a Relative Potency Factor (RPF) Approach for Polycyclic Aromatic Hydrocarbon (PAH) Mixtures"
  - ►EPA Science Advisory Board review complete
  - ►RPF approach retained but updated by new data/science

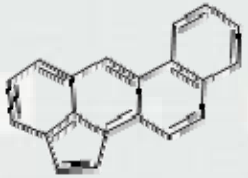
# Carcinogenic PAHs and Relative Potency Factors

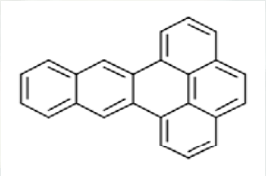
| | Current RPF | Draft RPF | Δ |
|---|---|---|---|
| Benzo(a)pyrene | 1 | 1 | |
| Benz(a)anthracene | 0.1 | 0.2 | 2x |
| Benzo(b)fluoranthene | 0.1 | 0.8 | 8x |
| Benzo(k)Fluoranthene | 0.01 | 0.03 | 3x |
| Chrysene | 0.001 | 0.1 | 100x |
| Dibenz(a,h)anthracene | 1 | 10 | 10x |
| Indeno(1,2,3-c,d)pyrene | 0.1 | 0.07 | |

# Additional PAHs from 2010 RPF Assessment

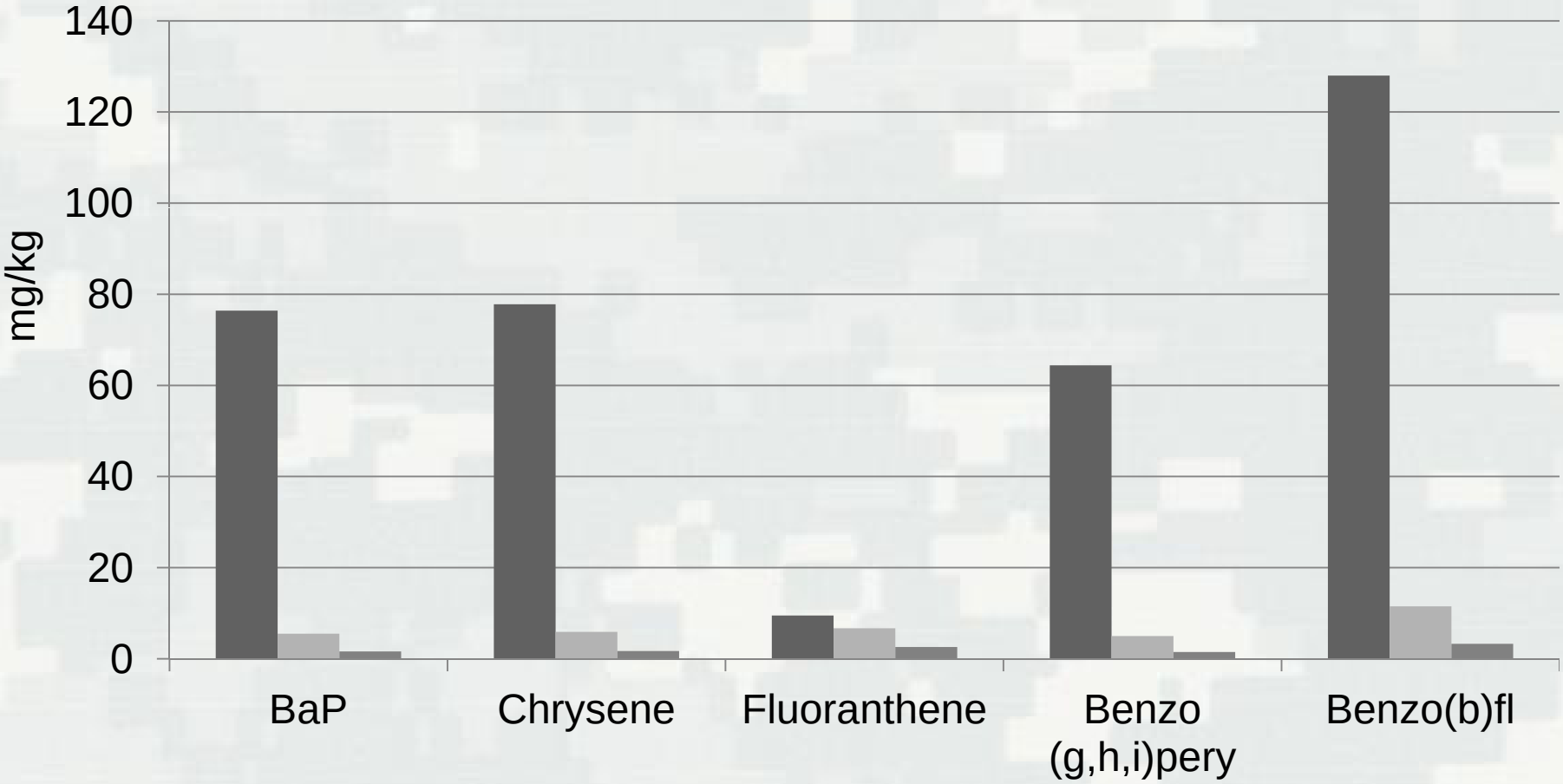
- Anthanthrene
- Benzo[g,h,i]perylene
- Benzo[j]fluoranthene
- Cyclopenta[c,d]pyrene
- Dibenzo[a,e]fluoranthene
- Dibenzo[a,e]pyrene
- Dibenzo[a,h]pyrene
- Dibenzo[a,i]pyrene
- Dibenzo[a,l]pyrene
- Fluoranthene

- Benz[b,c]aceanthrylene
- Benz[e]aceanthrylene
- Benz[j]aceanthrylene (60x)
- Benz[l]aceanthrylene
- Cyclopenta[d,e,f]chrysene
- Naphtho[2,3-e]pyrene





# Select PAHs from Sampled Areas

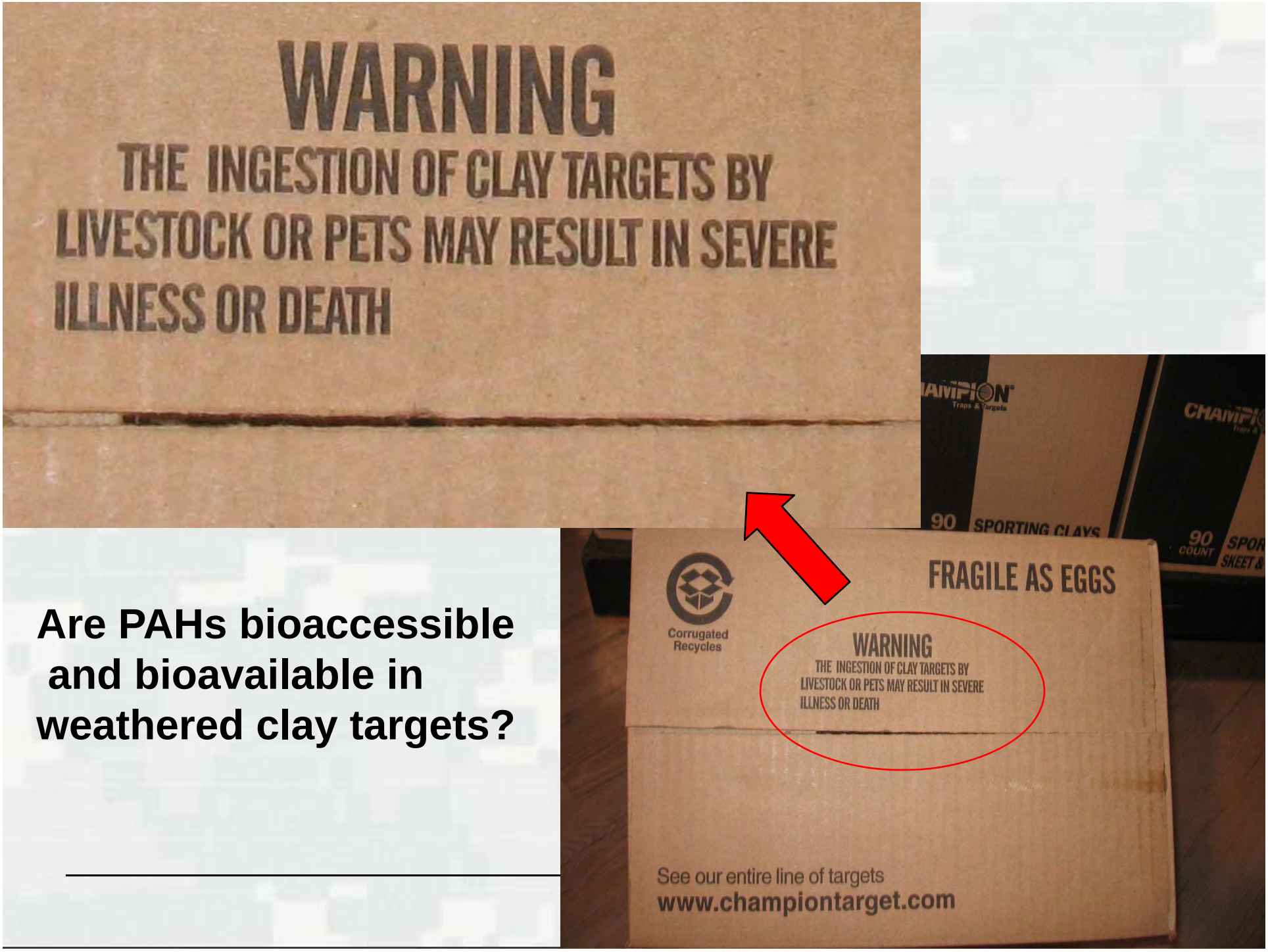


# Potential Impacts

| Analyte | High | Med | Low | Current RSL | Draft RSL | $10^{-4}$ RSL | Bkg |
|---|---|---|---|---|---|---|---|
| BaP | 76.4 | 5.5 | 1.6 | 0.015 | 0.015 | 1.5 | 0.014 |
| Chrysene | 77.8 | 5.9 | 1.7 | 15 | 0.15 | 15 | 0.012 |
| Fluoran-thene | 9.5 | 6.7 | 2.6 | | 0.188 | 18.8 | 0.018 |
| Benzo-(g,h,i)per ylene | 64.4 | 5 | 1.5 | | 1.67 | 167 | 0.032 |
| Benzo(b) fluoran-thene | 128 | 11.5 | 3.3 | 0.15 | 0.019 | 1.9 | 0.027 |

# Investigation Strategies

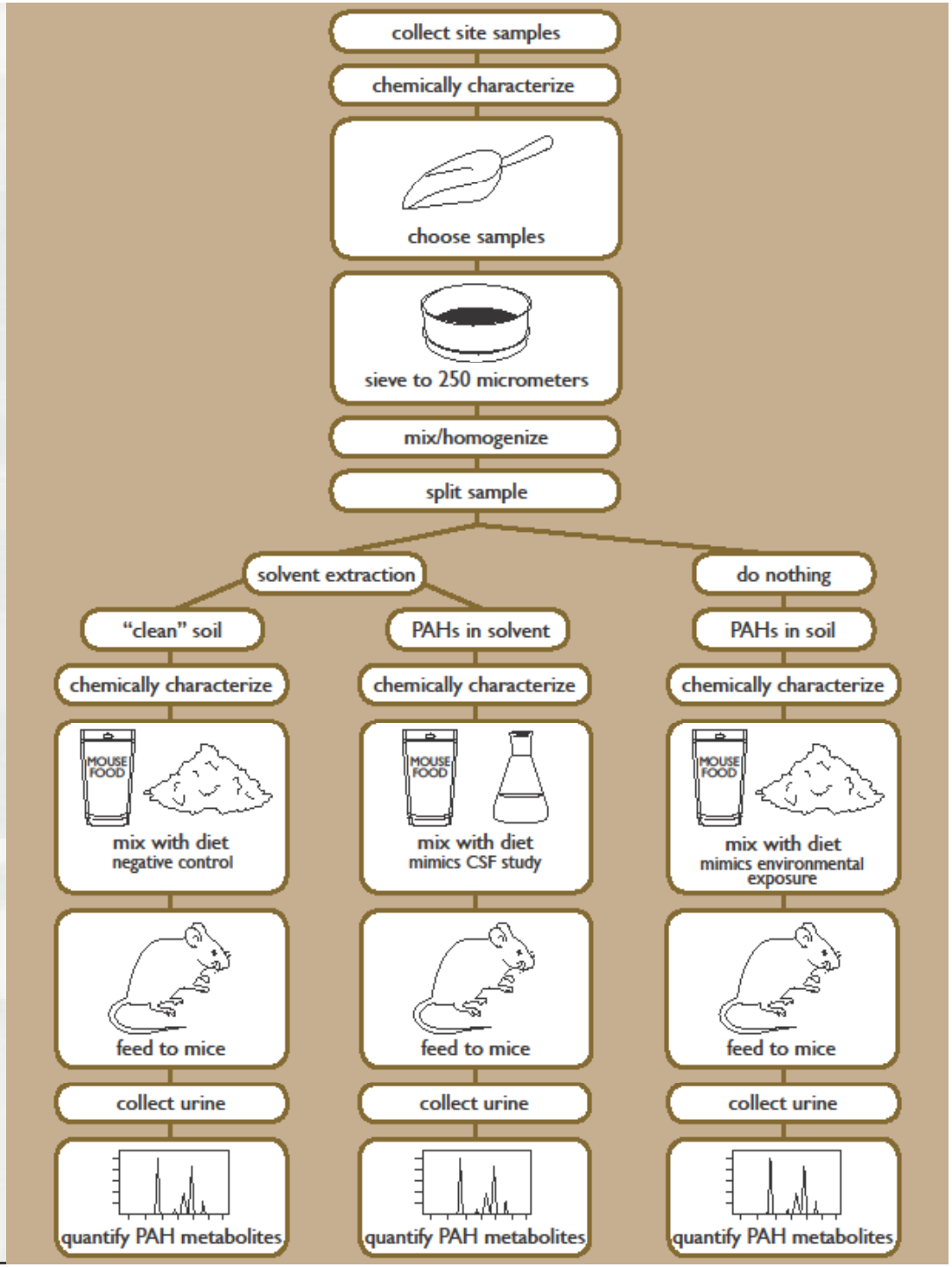
- Reduce uncertainty in CSM and in risk assessment; better informed decisions
  - Location/ size of fragments?  Likelihood of exposure?
  - Are risk assessment assumptions valid and representative of exposure?
  - Fragment size
  - Relative bioavailability




**Are PAHs bioaccessible and bioavailable in weathered clay targets?**

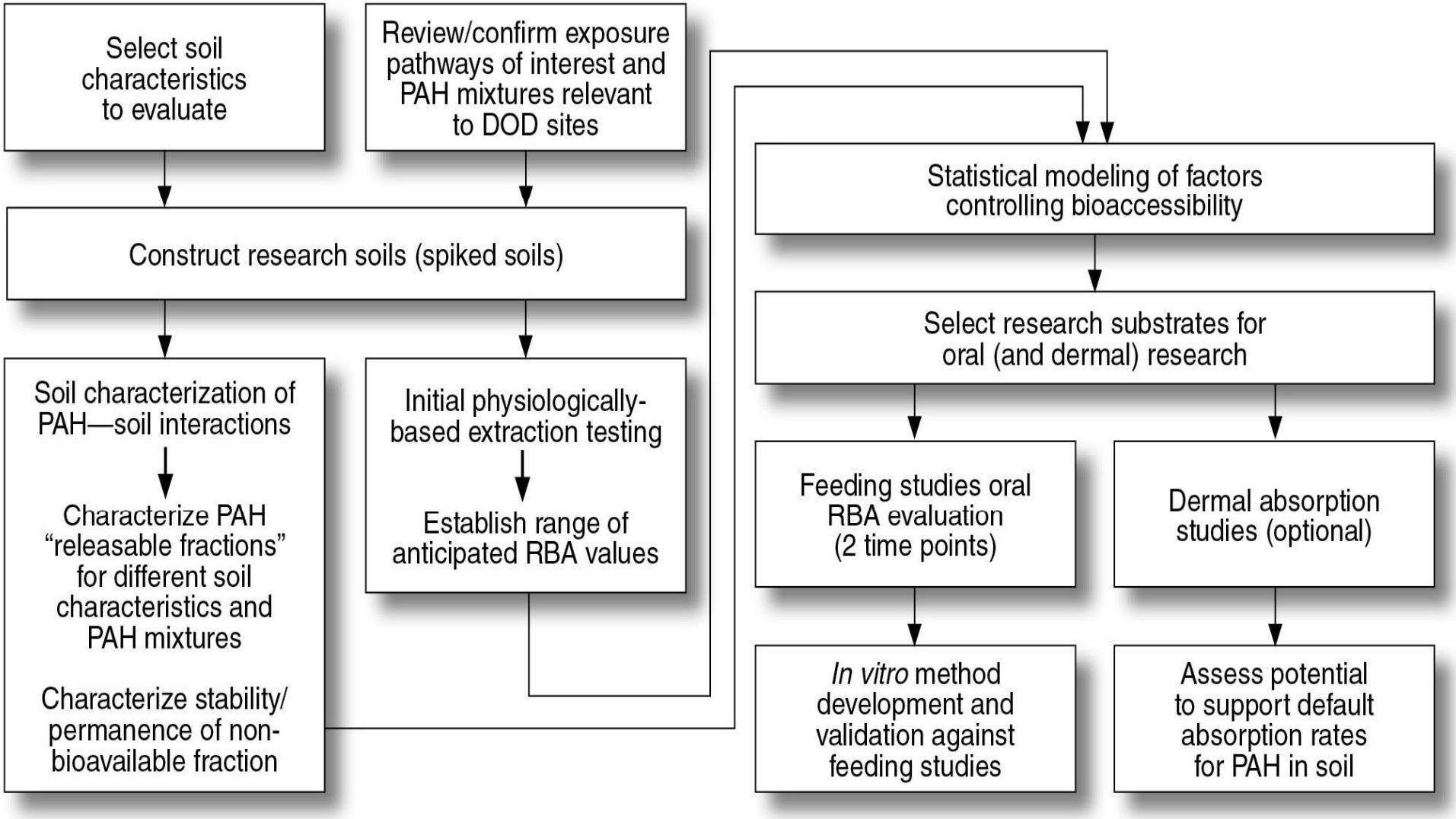
## Risk Management Strategies

- Draft plan for relative bioavailability study planned for Formerly Used Defense Site in TX



# DoD Funded Project

**PAH Bioavailability from Soils—Schematic of Project Tasks**



# Acknowledgments

Brian Jordan - USACE

Glenn Hoeger – Arcadis

Yvette Lowney and
Mike Ruby - Exponent